Small Business Innovation Research/Small Business Tech Transfer

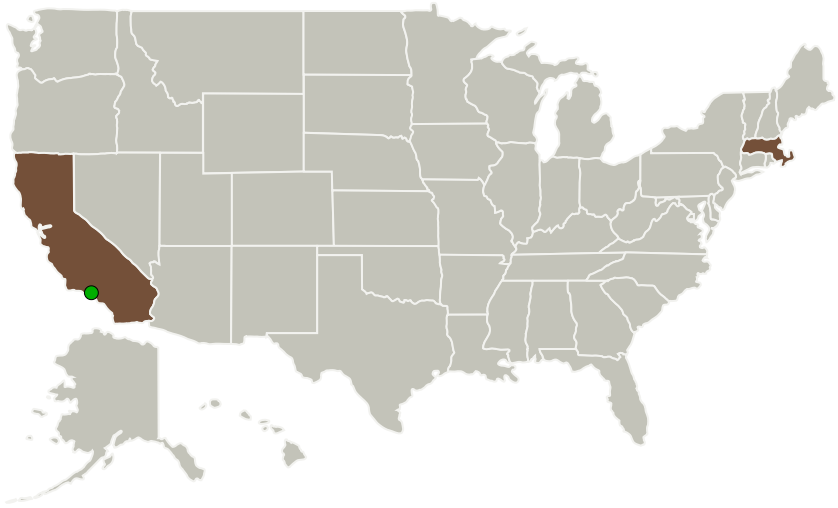
Improved Yield, Performance and Reliability of High-Actuator-Count Deformable Mirrors, Phase II

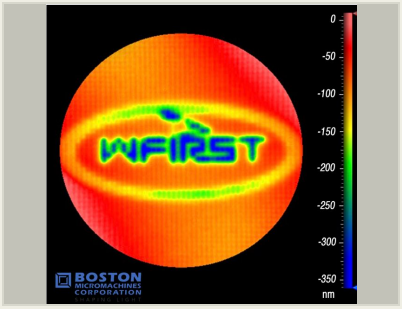
Completed Technology Project (2016 - 2020)

Project Introduction

The search for life on earth-like extrasolar planets has emerged as a compelling long-term scientific goal for NASA. That goal has inspired innovative space-based coronagraphs that aim to collect spectral data from earth-like planets orbiting stars in distant solar systems. NASA's SBIR Solicitation topic Proximity Glare Suppression for Astronomical Coronography calls specifically for small stroke, high precision, deformable mirrors and associated driving electronics scalable to 10,000 or more actuators. This research aims to overcome the two major technical problems that affect yield and lifetime of the micro-electro-mechanical system deformable mirrors (MEMS DMs) that currently define the state of the art for high-resolution wavefront control: (1) keyhole voids occurring during manufacturing (reducing manufacturing yield) and (2) field emission damage that occurs during device operation (reducing operational lifetime). In this project, the technical solutions to these problems that were demonstrated in the Phase I project will be integrated into a full DM wafer-scale surface-micromachining batch production run to make the first 100% working 2048-element MEMS DM. As a byproduct of the process enhancements developed in Phase I research, this run will feature unprecedented surface smoothness and exceptional device reliability and lifetime in addition to high yield. The devices will be produced in a form factor that can be used with the heritage coating, packaging, and testing technologies. They will fit into existing packages and will be controllable with existing driver technology. Consequently, they will allow rapid insertion of these new high-reliability DM devices into appropriate NASA test beds.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Boston Micromachines Corporation	Lead Organization	Industry	Cambridge, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

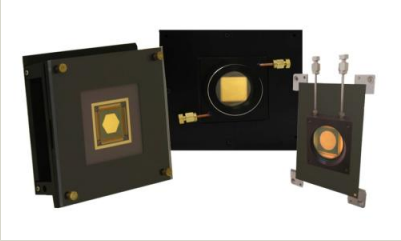
April 2016: Project Start

January 2020: Closed out

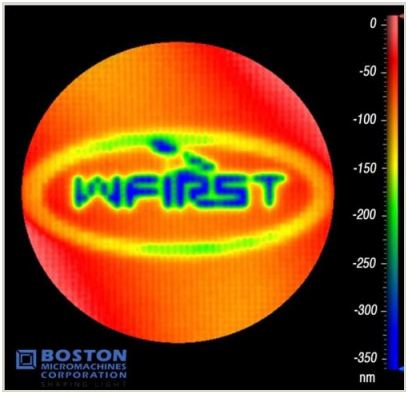
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139492)*

Images



Briefing Chart Image
Improved Yield, Performance and Reliability of High-Actuator-Count Deformable Mirrors, Phase II *(https://techport.nasa.gov/image/128541)*



Final Summary Chart Image
Improved Yield, Performance and Reliability of High-Actuator-Count Deformable Mirrors, Phase II *(https://techport.nasa.gov/image/129237)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Boston Micromachines Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

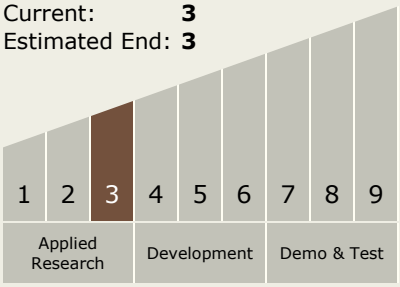
Carlos Torrez

Principal Investigator:

Peter J Ryan

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.3 Optical Components

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System